



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : G02B 26/02	A3	(11) International Publication Number: WO 99/52006 (43) International Publication Date: 14 October 1999 (14.10.99)
(21) International Application Number: PCT/US99/07271 (22) International Filing Date: 1 April 1999 (01.04.99) (30) Priority Data: 09/056,975 8 April 1998 (08.04.98) US (63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application US 09/056,975 (CON) Filed on 8 April 1998 (08.04.98) (71) Applicant (for all designated States except US): ETALON, INC. [US/US]; Suite 501, 354 Congress Street, Boston, MA 02110-1237 (US). (72) Inventor; and (75) Inventor/Applicant (for US only): MILES, Mark, W. [US/US]; Suite 501, 354 Congress Street, Boston, MA 02110-1237 (US). (74) Agent: FEIGENBAUM, David, L.; Fish & Richardson P.C., 225 Franklin Street, Boston, MA 02110-2804 (US).		(81) Designated States: KR, US. Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 29 December 1999 (29.12.99)
(54) Title: INTERFEROMETRIC MODULATION OF RADIATION (57) Abstract <p>The invention features an interferometric modulator comprising a cavity defined by two walls. At least two arms connect the two walls to permit motion of the walls relative to each other. The two arms are configured and attached to a first one of the walls in a manner that enables mechanical stress in the first wall to be relieved by motion of the first wall essentially within the plane of the first wall.</p> <div> </div>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

INTERNATIONAL SEARCH REPORT

Internatic Application No

PCT/US 99/07271

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G02B26/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G02B B81C G09F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 95 30924 A (ETALON INC ;MILES MARK W (US)) 16 November 1995 (1995-11-16) page 33, line 20 -page 34, line 15; figure 28 --- -/--	1-8,10, 11,15, 23,24 14

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- * "A" document defining the general state of the art which is not considered to be of particular relevance
- * "E" earlier document but published on or after the international filing date
- * "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- * "O" document referring to an oral disclosure, use, exhibition or other means
- * "P" document published prior to the international filing date but later than the priority date claimed

- * "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- * "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- * "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- * "&" document member of the same patent family

Date of the actual completion of the international search

12 August 1999

Date of mailing of the international search report

10. 11. 1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

SCHEU, M

INTERNATIONAL SEARCH REPORT

Internat	Application No
PCT/US 99/07271	

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>ARATANI K ET AL: "PROCESS AND DESIGN CONSIDERATIONS FOR SURFACE MICROMACHINED BEAMS FOR A TUNEABLE INTERFEROMETER ARRAY IN SILICON"</p> <p>PROCEEDINGS OF THE WORKSHOP ON MICRO ELECTRO MECHANICAL SYSTEMS (ME, FORT LAUDERDALE, FEB. 7 - 10, 1993, no. WORKSHOP 6, 7 February 1993 (1993-02-07), pages 230-235, XP000366885</p> <p>INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS ISBN: 0-7803-0957-X</p> <p>page 232</p>	1-8,10, 11,15
X	<p style="text-align: center;">---</p> <p>GOOSSEN K W ET AL: "SILICON MODULATOR BASED ON MECHANICALLY-ACTIVE ANTI-REFLECTION LAYER WITH 1 MBIT/SEC CAPABILITY FOR FIBER-IN-THE-LOOP APPLICATIONS"</p> <p>IEEE PHOTONICS TECHNOLOGY LETTERS, vol. 6, no. 9, 1 September 1994 (1994-09-01), pages 1119-1121, XP000468079</p> <p>ISSN: 1041-1135</p> <p>the whole document</p>	1-7, 9-11,15
X	<p style="text-align: center;">---</p> <p>EP 0 667 548 A (AT & T CORP)</p> <p>16 August 1995 (1995-08-16)</p> <p>column 3, line 12 - line 35</p> <p>column 4, line 54 -column 6, line 30;</p> <p>figure 2</p> <p style="text-align: center;">-----</p>	1-7, 9-11,15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 99/07271

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-15,23,24

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-15,23,24

An interferometric modulator comprising a cavity defined by two walls wherein the first wall is movable relative to the second wall and within the plane of the first wall

2. Claims: 16-18

Interferometric modulator comprising three walls and control circuitry for driving at least one of three walls

3. Claims: 19-20

an interference modulator comprising spacers mounted to form part of one of the walls

4. Claims: 21,22,25

Interference modulator comprising means to control the response time of the modulator

5. Claim : 26

Interferometric modulator comprising a charge deposition mitigating device

6. Claims: 27-32

An interferometric modulator, comprising walls and a support and at least one of the walls or the support comprising at least two materials

7. Claims: 33-38,44-48

A method of etching and patterning a microelectromechanical structure

8. Claims: 39-43

a method of making arrays of microelectromechanical structure on a production line

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 99/07271

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9530924 A	16-11-1995	US 5835255 A EP 0801766 A JP 10500224 T	10-11-1998 22-10-1997 06-01-1998
EP 0667548 A	16-08-1995	US 5500761 A CA 2137063 A US 5654819 A US 5589974 A	19-03-1996 28-07-1995 05-08-1997 31-12-1996

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record.**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

☐ BLACK BORDERS

☒ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES

☒ FADED TEXT OR DRAWING

☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING

☐ SKEWED/SLANTED IMAGES

☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS

☐ GRAY SCALE DOCUMENTS

☒ LINES OR MARKS ON ORIGINAL DOCUMENT

☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY

☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.